Adaptive User-Aware Dashboard Design

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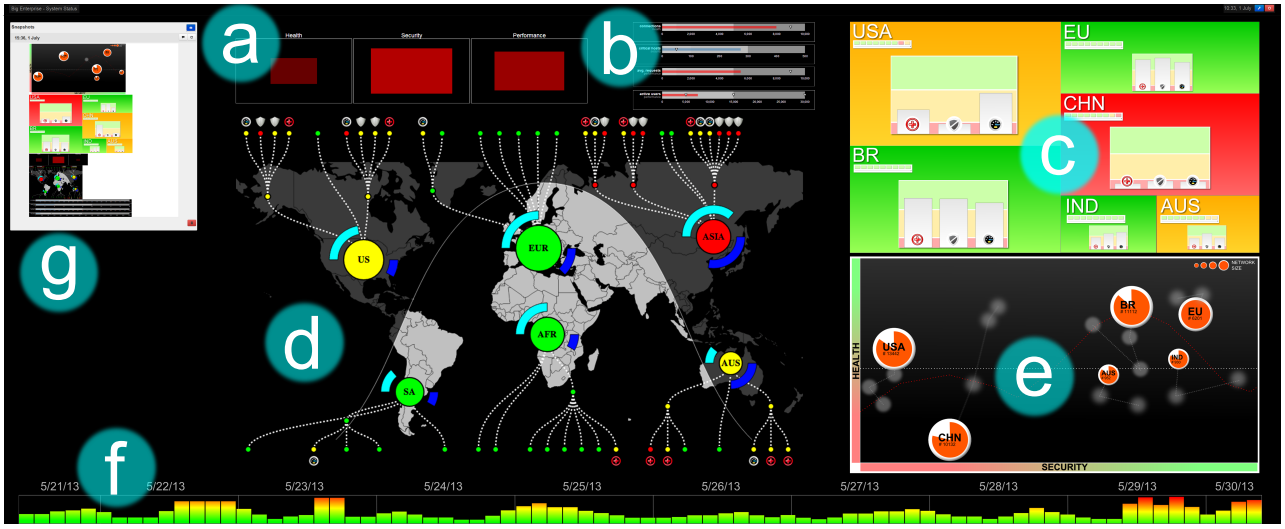

Figure 1: The visual design of system is represented as dashboard and consists of several widgets: (a) Indicator Overview, (b) Bullet-Spark Chart, (c) Treemap, (d) Maptrogram, (e) Netrium (*Net*work and Aqua*rium*), (f) Event Timeline, and (g) Snapshot.

Index Terms: C.2.3 [Computer-Communication Networks]: Network Operations—Network monitoring; I.3.8 [Computer Graphics]: Applications; H.5.2 [Information Interfaces and Presentation]: User Interfaces—Graphical user interfaces; H.5.2 [Information Interfaces and Presentation]: User Interfaces—Screen design;

1 Introduction

The task of the VAST 2013 Mini-Challenge 2 (MC2) was the design of a system targeting the surveillance and the visualization of the current state of the corporate network of Big Enterprises. According to the task given, we focus on displaying three main measures: *health*, *security*, and *performance* of the network.

In our approach, we propose a novel visual design, and a new interaction concept and design. In order to create a fresh perspective on situational awareness, we do not only focus on the scalability of the visual design, but also propose a new display that consist of three important key concepts: User-Aware Adaptiveness (UAA), Shared Collaborative Queues (SCQ), and a combination of different novel widget charts.

Our paper is structured as follows: In section 2, we first provide an overview of the basic concepts, the User-Aware Adaptiveness as well as the Shared Collaborative Queues. The second part focuses on the widgets charts, describing each of them separately. We conclude with a short summary in section 3.

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2 Concepts

Systems providing a *situational awareness display* are usually designed to display the current status of monitored system(s) to support analysts in perceiving the current status. In our design, the situational awareness is extended also on the analyst's side. Our display is capable of detecting when no analyst is in front of the display or the analyst doesn't look in its direction. In those situations, our User Aware Adaptiveness comes into play.

User Aware Adaptiveness (UAA)

Our UAA tackles the problem, that the highly relevant status history for the sense making of the current situation has not been observed when the analyst focuses again the display. Our system switches to an aggregation mode in case the analysts loose focus on the display. In this mode, all widgets are grayed out and the incoming data for each of the widgets is aggregated (see figure 2). When the display detects analyst attention again, the default mode is reactivated and each widget displays the data from the past in its so called history mode. This mode is designed for each widget separately and allows the analyst to get a quick overview of the displayed metrics for the time he didn't focus the display. With this feature, we emphasize the analyst's ability to make sense out of the current situation, even if he didn't focus on the display all time. As far as we know, such support is not available in today's state of the art systems.

Shared Collaborative Queues (SCQ)

A situational awareness display can be used to detect critical situations or other events in the displayed widgets. Since the analyst in front of the display can not focus on further investigations of such events, our design incorporates the *SCQs* (see figure 1, g). These

Figure 2: The display in aggregation mode.

queues can be filled by the analyst with snapshots of the current situation, and are shared between different analysts and workplaces. With this technique, the analyst using the display is able to keep up with the situation and its changes while potentially important events can be examined by other analysts. The single entries of the queue can be annotated with notes or marked as investigated. Our approach supports a human-driven decision making process, and the analyst working with the situational awareness display can incorporate findings from co-workers in his current assessment of the situation.

Widget Concepts

We propose several novel widget designs. A number of visualization techniques have already been developed, for example, as part of previous VAST challenges ([2]) which were taken as a basis for further investigations. All visualizations refer to the same system state, and are therefore automatically linked to each other.

The widgets display three metrics: health, security, and performance. For each metric, we assume three main states: *normal* (green), *routine* (yellow), and *critical* (red).

The *Overview Indicator Widget* (figure 1, a) is built to provide an overview of the different metrics. Each of the displayed metrics is visualized with two nested rectangles: The outer one determines the outer border of the visualization, the inner one is scaled according to the value of the displayed condition. It is also filled with a color, where black indicates not having data at all, and red shows the critical condition.

Stephen Fews Bullet Graph [1] inspired the *Bullet-Spark Chart Widget* (figure 1, b). We introduce a modified version, which embeds sparklines for the history mode.

The *Treemap Widget* (figure 1, c) displays the three metrics and an aggregated measure for different subsidiaries of the company. The idea of using a treemap to visualize a network has already been presented, for example, in the work of Mansmann et al. [3]. We choose a different way to represent the network, where each cell represents the subnet located in a country. The cell size reflects the number of autonomous systems in the network, which we assume to directly reflects its importance. The cells background color matches the overall subnet status as described before. Each of the metrics is shown with a bar, where the overall status is mapped to its height. To be able to easily recognize the bar status, we introduce a double encoding where not only the height of the bar, but also its background is used to show the overall status. In case the cell is not large enough to hold the bar chart, the background color can be interpreted as the current system state and the bar chart is left out. To compare the current system state with the past, small indicators of the overall state are shown below the cell name.

The *Maptrogram Widget* (figure 1, d) provides a top level hierarchy overview of the global company network. The circles represent the most active subnets and their size the amount of autonomous systems in the subnet. The position of a circle is determined by the geo-location of the subnet, its color indicates the aggregated state. The arcs enclosing the root-circles correspond to the incoming and outgoing subnet flows. In addition, the upper levels of the subnet hierarchies are added to the root-circles. All leafs of each single subnet tree are positioned on a common line above and below the map. To identify the source of incidents, an icon - added to the corresponding leaf - reveals the dominating incident type (performance, health, or security) within the subnet. In order to inspect the network hierarchy, the nodes are linked with other widgets such as the treemap. Besides, the nodes are interactively expandable and can change their layout according to the representation needed by the analyst. This widget is a combination of a geo-map and different techniques to display hierarchical trees such as a dendrogram.

The so called *Netrium Widget* (figure 1, e) comes from a combination of the words *network* and *aquarium* and allows the surveillance of networks over time. A clear advantage of the Netrium widget is the combination of overview and detail. It offers an easy understandable overview but also several details: The x-axis maps the security status and the y-axis the health status of the corresponding subnet. Analysts can easily identify changes by keeping focus on the quadrants. Moreover, the moving circles correspond to a certain subnet with its size corresponding to the subnet size. The pie chart contained by each circle displays the amount of connections in the subnet. One of the most important features of the Netrium widget is the ability to show major changes over time as the path of each circle. Also, a sparkline in the background denotes the overall development of the network. To reduce clutter, only countries above a certain threshold are visualized. The Netrium is inspired by the Gapminder visualization [4].

3 Conclusion

Our proposed design for a situational awareness display utilizes multiple, novel widget designs. In addition to the widgets, we add novel techniques like User-Aware Adaptiveness and Shared Collaborative Queues. The history mode of each widget provides a context for the displayed situation after the analysts attention was distracted. The SCQs are a utility for deep integration of the situational awareness display into the analytical process. Each of the described widgets serves a specific purpose, and their combination leads to a useful and meaningful system, showing the status of Big Enterprises corporate network and provides monitoring and analysis features.

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